

Course Description**PCB4023 | Molecular and Cell Biology | 3.00 credits**

Students will learn the structure and function of cells and biological membranes, signal transduction pathways, cell cycle and cell division, the flow of genetic information and the regulation of gene expression. Exploration of laboratory techniques and discussion of the cellular basis of human diseases will also occur. Prerequisites: BSC2010, 2010L, 2011, 2011L.

Course Competencies:

Competency 1: The student will demonstrate an understanding of cell structure and function by:

1. Differentiating between Eukaryotic and Eukaryotic cells, describing their differences and similarities
2. Differentiating between the animal and plant cells, describing their differences and similarities
3. Analyzing the importance of subcellular compartmentalization
4. Identifying the subcellular organelles and describing their structure and function
5. Explaining the structural and functional diversity among cells due to cell differentiation
6. Describing how cells integrate into tissues

Competency 2: The student will demonstrate knowledge of the tools and methods needed to study cell structure and function by:

1. Explaining the principles of microscopy
2. Differentiating between light and electron microscopy
3. Explaining different types of microscopic techniques and sample processing to label and identify subcellular structures in fixed and live cells
4. Analyzing micrographs to identify different subcellular structures and collect data

Competency 3: The student will demonstrate an understanding of the structure and function of biological membranes by:

1. Analyzing the chemical composition of biological membranes and the process involved in membrane biogenesis
2. Describing the structural components of the membrane and their function
3. Explaining the fluid mosaic nature of membrane structure and how it determines its functions
4. Describing the different types of cellular junctions in plant and animal cells
5. Explaining the processes responsible for transport across membranes and the role of the proteins involved in different types of transport
6. Describes vesicle trafficking in cells
7. Discussing the role of membranes and membrane proteins in energy conversion processes

Competency 4: The student will demonstrate an understanding of the functioning of signal transduction pathways by:

1. Identifying the components of a general signal transduction pathway
2. Explaining the differences between a gpcr and a tkr, and providing examples of pathways initiated by these receptors
3. Identifying first and second messengers and explaining their differences
4. Explaining the different cascades of reactions that result in the production of second messengers
5. Explaining the processes of protein phosphorylation and de-phosphorylation and their impact on protein function, explaining cellular responses

Competency 5: The student will demonstrate knowledge of the role of DNA in cell biology by:

1. Explaining the process of DNA replication and its regulation
2. Explaining the process of transcription
3. Analyzing the genetic code and explaining the differences among the different ribonucleic acids
4. Explaining the process of translation in protein synthesis

5. Explaining the exocytic pathway in Eukaryotic cells, including protein chemical modifications in the Rough Endoplasmic Reticulum and the Golgi

Competency 6: The student will demonstrate knowledge of the regulation of gene expression by:

1. Identifying the different levels of regulation of gene expression
2. Analyzing DNA chemical modifications and their impact on chromatin remodeling and the regulation of gene expression
3. Explaining the functional differences between prokaryotic and eukaryotic genes
4. Explaining the regulation of transcription in prokaryotic and eukaryotic
5. Explaining the effect of co- and post-translational modifications of proteins on their function

Competency 7: The student will demonstrate an understanding of the processes of cell division and the cell cycle by:

1. Describing the events of each phase of the eukaryotic cell cycle
2. Demonstrating an understanding of the mitotic phase, nuclear, and cell division
3. Describing the cell cycle progression and cell cycle regulation (i.e., knowing the factors that regulate and control the cell cycle, such as maturation-promoting factor (MPF) and cyclin-dependent kinases (CDK), -cyclin complex, and checkpoint mechanisms).
4. Understanding the role of growth factors in cell proliferation and understanding uncontrolled cell division and cancer biology
5. Discussing cell damage and repair and programmed cell death (apoptosis)

Competency 8: The student will demonstrate an understanding of the standard lab practices in molecular biology by:

1. Explaining the mechanism of action of restriction enzymes and analyzing the outcome of restriction reactions
2. Explaining nucleic acid hybridization techniques and analyzing the outcome of different hybridization reactions
3. Explaining in vitro transcription
4. Explaining PCR and RT-PCR reactions and designing DNA primers
5. Differentiating plasmid, cosmid, and phage structure and use
6. Discussing the advantages and disadvantages of transformation versus electroporation
7. Designing cloning strategies for prokaryotic and eukaryotic genes
8. Explaining the methods to study protein-protein interactions

Competency 9: The student will demonstrate an understanding of the cellular basis of human diseases by:

1. Explaining how the study of cell biology has resulted in medical advances
2. Discussing current biomedical issues in a cellular context: cystic fibrosis, HIV aids, Alzheimer's disease
3. Comprehending and critiquing scientific literature

Learning Outcomes:

- Communicate effectively using listening, speaking, reading, and writing skills
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information
- Describe how natural systems function and recognize the impact of humans on the environment